

Monitoring, Research, and Evaluation

Several important monitoring activities are occurring throughout the Columbia River basin that have a direct bearing on the estuary, plume, and nearshore. They include those associated with the following:

- Draft *Federal Columbia River Estuary Research, Monitoring, and Evaluation Program* (Johnson et al. 2006)
- Lower Columbia River Estuary Partnership (1998)
- Recovery plans for salmon species of the Columbia Basin listed under the U.S. Endangered Species Act (National Oceanic and Atmospheric Administration 2005)
- Washington and Oregon salmon recovery programs (Washington Salmon Recovery Funding Board 2002 and Oregon Watershed Enhancement Board 2005)
- Federal Columbia River Power System Biological Opinion implementation (National Oceanic and Atmospheric Administration 2003, Johnson et al. 2004, Upper Columbia Regional Technical Team 2004, and Independent Science Advisory Board and Independent Science Review Panel 2004)
- Northwest Power and Conservation Council's *Columbia River Basin Fish and Wildlife Program* (Northwest Power and Conservation Council 2004)
- Pacific Northwest Aquatic Monitoring Partnership (2005a and 2005b)
- Collaborative Systemwide Monitoring and Evaluation Project (Columbia Basin Fish and Wildlife Authority 2005)

In the development of this estuary recovery plan module, it was recognized that creating a new monitoring plan for the estuary, plume, and nearshore would, at best, only duplicate some of the maturing efforts identified above. In particular, the draft *Federal Columbia River Estuary Research, Monitoring, and Evaluation Program* (Johnson et al. 2006) is recognized as the appropriate monitoring plan to complement the estuary recovery plan module. This monitoring plan is important because it links the estuary module to the 2000 and 2004 biological opinions on operation of the Federal Columbia River Power System. Also, the Federal Columbia River Estuary Research, Monitoring, and Evaluation (ERME) Program has a standing estuary/ocean subgroup that continues to refine the monitoring plan; the group's members include the Bonneville Power Administration, the U.S. Army Corps of Engineers, the Lower Columbia River Estuary Partnership, NOAA Fisheries, and the Pacific Northwest National Laboratory. Finally, versions of the ERME Program's monitoring plan were reviewed by the Independent Scientific Review Panel and the Independent Science Advisory Board and other state and tribal fisheries management agencies. This represents important institutional capacity to ensure successful implementation of the monitoring plan over time.

Status and Trends Monitoring

Status and trends monitoring includes the collection of standardized basic information used to monitor broad-scale trends over time in the status of fish populations, conditions in the habitat they use, and other ecosystem factors that affect fish. Status and trends monitoring typically includes the core elements of any monitoring program, such as annual fish numbers and survival rates. This information serves as the basis for evaluating the cumulative effects of suites of management actions on fish, habitat, and the ecosystem.

The overall objective of status and trends monitoring in the ERME Program's monitoring plan is to "measure the status and trends of monitored indicators that are ecologically significant to listed salmonids in the lower river, estuary, plume, and nearshore ocean" (Johnson et al. 2006). The following sub-objectives are from the ERME Program document:

- STM 1: Evaluate the status and trends of stressors for ecosystem controlling factors at an estuary-wide scale.
- STM 2: Evaluate the status and trends of factors controlling ecosystem structures and processes at site and estuary-wide scales.
- STM 3: Evaluate the status and trends of ecosystem structures at site and landscape scales.
- STM 4: Evaluate the status and trends of ecosystem function—juvenile salmonid performance—at the site scale.

Additional information about status and trends monitoring objectives and their relationship to a conceptual model can be found in the May 2006 draft version of the *Federal Columbia River Estuary Research, Monitoring, and Evaluation Program* (Johnson et al. 2006).

Action Effectiveness Research

Action effectiveness research involves project-scale monitoring of local conditions to determine whether implemented actions were effective in creating the desired proximate change. Action effectiveness monitoring typically is used to determine whether project- or program-specific performance goals are met. This type of monitoring also includes post-project monitoring to see whether the actions continue to function as they were designed or intended. In some cases the information needed for action effectiveness research may be provided by status monitoring, but action effectiveness research generally requires focused evaluations of more specific parameters directly associated with actions.

The overall objective of action effectiveness research in the draft *Federal Columbia River Estuary Research, Monitoring, and Evaluation Program* is to "use quantitative studies to demonstrate how habitat restoration actions affect factors controlling ecosystem structures and processes at site and landscape scales and produce changes in juvenile salmonid performance" (Johnson et al. 2006). The following sub-objectives are from the ERME Program document:

- AER 1: Measure the effects of individual habitat restoration actions at project sites relative to reference sites and evaluate post-restoration trajectories based on project-specific goals and objectives (effectiveness monitoring).

- AER 2: Estimate the collective effects of habitat conservation and restoration projects in terms of cause-and-effect relationships between ecosystem controlling factors, structures, and processes affecting salmon habitats and performance (validation monitoring).

Additional information about the action effectiveness research objectives and their relationship to a conceptual model can be found in the May 2006 draft version of the *Federal Columbia River Estuary Research, Monitoring, and Evaluation Program* (Johnson et al. 2006).

Uncertainties Research

Uncertainties research consists of scientific investigations of critical assumptions and unknowns that constrain effective recovery plan implementation. Uncertainties include currently unavailable pieces of information required for informed decision making, as well as studies to establish or verify cause-and-effect relationships among fish, limiting factors, and projects or programs meant to protect or enhance fish production or affect limiting factors.

The overall objective of uncertainties research in the draft *Federal Columbia River Estuary Research, Monitoring, and Evaluation Program* is to answer the question, “What are the key uncertainties in the state-of-the-science on the estuary that prevent the achievement of habitat, fish, or wildlife performance objectives in the Columbia Basin and how can these be reduced?” (Johnson et al. 2006). The following sub-objectives are from the ERME Program document:

- UR 1: Quantify the ecological importance of the estuary and nearshore ocean in terms of the relationships between salmon population performance and ecosystem structures, ecological processes, life history patterns, and genetic conditions.

Uncertainties:

- 1a. *Linkage between habitat conditions and growth and survival of juvenile salmonid fishes in the estuary and ocean.*
 - 1b. *Ecosystem controlling factors, structures, and processes of the estuary and ocean that are limiting for the salmon ESUs.*
 - 1c. *Survival rates and factors affecting survival in the estuary and plume for the salmon ESUs.*
 - 1d. *Effect of timing of ocean entry and, during this period, whether concurrent monitoring of ocean conditions and salmonid migration patterns, growth, and survival can be used to predict inter-annual variations in sizes of runs of returning adult salmonids.*
- UR 2: Identify land and water management actions, such as Federal Columbia River Power System (FCRPS) operations, which could improve estuary habitats.

Uncertainties:

- 2a. *Effects of hydrograph changes due to the FCRPS on juvenile salmon habitat opportunity, structure, and function.*
- 2b. *The primary driver of the historic estuarine food web.*
- 2c. *The importance of the estuary actions relative to actions in the hydrosystem and tributary habitats.*

- UR 3: Prioritize habitats and locations for conservation and restoration in the estuary.

Uncertainties:

- 3a. *The extent of habitat usage by juvenile salmon in the tidal freshwater reach of the estuary (RM 46 to 146).*
 - 3b. *The spatial and temporal usage of estuary habitats by listed salmonids with various life histories.*
 - 3c. *The accessibility of habitat to juvenile salmon.*
 - 3d. *The hydrogeomorphic classification of habitats in the Columbia River estuary.*
- UR 4: Determine the effects of toxics on salmonid performance in the Columbia River estuary.

Uncertainties:

- 4a. *The distribution and concentration of toxics in the Columbia River estuary.*
- 4b. *The effect toxics have on salmonid performance.*

One of the critical uncertainties that has emerged in preparation of this estuary recovery plan module is the degree of density-dependent mortality that is occurring in the estuary and the role of large releases of hatchery fish in density dependence. Additional research is needed to explore this topic and understand more clearly how mechanisms of density dependence relate to the limiting factors identified in the module. This is a category of research consistent with Subobjective UR 1 of the ERME Program document (“Quantify the ecological importance of the estuary and nearshore ocean in terms of the relationships between salmon population performance and ecosystem structures, ecological processes, life history patterns, and genetic conditions”) and Uncertainty 1a (“Linkage between habitat conditions and growth and survival of juvenile salmonid fishes in the estuary and ocean”).

Additional information about the uncertainties research objectives and their relationship to a conceptual model can be found in the May 2006 version of the *Federal Columbia River Estuary Research, Monitoring, and Evaluation Program* (Johnson et al. 2006).

Data and Information Management

Data and other information pertinent to the ERME are appropriately collected by many parties for a wide variety of applications, including but not limited to the ERME. Data analysis and management are performed at a project and sometimes agency level, but not at a program level (Johnson et al. 2004). It is neither desirable nor feasible to centrally coordinate all data collection activities. However, application of pertinent data to the evaluation of the ERME will be facilitated by the organization of a coordinated collaborative information network that includes the following elements:¹

- Incorporation of data produced by existing programs and information systems to avoid duplication of effort.
- Establishment of an estuary monitoring, research, and evaluation (MR&E) information-sharing committee that includes technical representatives of action agencies, the Lower Columbia River Estuary Partnership, and other entities involved in implementation and

¹ Adapted from Johnson et al. (2003) and Lower Columbia River Estuary Partnership (2004).

monitoring. This information-sharing committee would complement corresponding groups of policy representatives responsible for implementation.

- Integration with other basinwide MR&E groups, including the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) and the Collaborative Systemwide Monitoring and Evaluation Project (CSMEP).
- Regular written project-level reporting by MR&E partners.
- A coordinated system for peer review of project plans and reports.
- Periodic estuary MR&E workshops to present new data, discuss findings, and exchange information on future plans.
- Establishment of a central, Web-accessible repository and library for estuary data and references.
- Guidelines for metadata standards to facilitate data exchange and application.
- Centrally facilitated program-level review for comprehensive synthesis and evaluation of pertinent information relative to the goals and objectives of this plan.
- Periodic program-level summary reports.
- Consistent participation and funding commitments by partners.

Next Steps

Monitoring, research, and evaluation, elements identified in the draft *Federal Columbia River Estuary Research, Monitoring, and Evaluation Program* (Johnson et al. 2006) provide a consistent methodology that complements the management actions identified in Chapter 5 of the estuary recovery plan module. However, activities conducted as part of the ERME Program do not fully address all of the monitoring needs associated with the 23 management actions identified in the module. As of this writing, a process was under way to identify (1) gaps between existing monitoring efforts and needed monitoring for the management actions, and (2) additional recommended monitoring activities to fill those gaps and thus ensure that the necessary monitoring is conducted to support all of the 23 management actions. As part of this process, estuary monitoring activities – both existing and new – are being reviewed for consistency with a recently released NOAA Fisheries guidance document on monitoring, research, and evaluation for ESA-listed salmonids (NOAA Fisheries 2007). Detailed information on any new, recommended monitoring activities, including indicators, protocols, and estimated costs, will be presented in this estuary recovery plan module.

As actions in the module are implemented, it will be important to further integrate monitoring and research activities to ensure that recovery actions are achieving the desired results and that key uncertainties are further explored. Incorporating into the management actions new information that emerges from monitoring, research, and evaluation activities – either new activities specified in the estuary recovery plan module or activities that are part of the ERME Program – would enhance the effects of any actions that are implemented as a result of the module.

